Carnegie Mellon University

Speech Lab Universidad de Navarra

C.A.R.E Framework

Laboratory Phonology in the Phonetics/Phonology Classroom

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Who and Where We Are

Department of Philosophy, CMU

Department of Linguistics, UNAV

Both teach a combined Phonetics & Phonology class

C.A.R.E Framework

Core idea: Do research with students in the classroom!

Collaborative

Disciplinary collaboration in the classroom

- faculty-faculty
- student-student
- faculty-student

Active-learning

Active-learning promotes student engagement

- learn by doing
- inherent to research

Research-based

Research in the undergraduate classroom

- pedagogical benefits
- integration with university mission

Education

Scholarship of Teaching and Learning (SoTL)

- skillset to teach
- paper under revision (*Teaching Linguistics*) so materials will be available

Skills: Research-relevant & Transversal

Research-relevant skills	Transversal skills
Hypothesis generation • Understand the existing state of knowledge regarding the problem at hand • Have sufficient background knowledge (i.e., command of relevant background literature) • Understand how available methodologies may provide answers to research questions • Understand relationship between specific measures and hypotheses	• Active engagement with complex material required in order to ask questions and formulate hypotheses • Translation of vague ideas into quantifiable questions • Creativity
Spring 2019: simulated through written assignments and discussion	
Corpus creation • Understand hypothesis sufficiently in order to create corpus • Consolidate background (linguistic, phonological, phonetic) knowledge so that corpus is sufficiently controlled • Relate measures to corpus items (e.g., understanding that VOT cannot be measured in word-initial voiceless stops in a purely acoustic study)	• Attention to detail • Organization
Spring 2019: simulated through written assignments and discussion	

C.A.R.E Belief Structure

We believe research skills…

- … are acquired / can be taught
- … emerge naturally from collaboration
  - peer-to-peer and with faculty
- … individual, but for public use
  - every student has *something* to bring to the table

We believe students…

- …can do sophisticated research with:
  1. **Structure**
  2. **Support**
  3. **Scaffolding**
- …are research peers
- …will take ownership of their learning if they are engaged with the topic

Components of Project

- IRB
- Literature
- Hypothesis development
- Stimuli generation
- Data collection
- Segmentation
- Measures / outlier detection
- Statistical analysis
- Write up / presentation

Pedagogical approach:

1. **active learning: full engagement (segmentation)**
   students fully engaged in decision-making
2. **active learning: simulation (hypothesis generation)**
   students guided through already-made decisions
3. **just believe us: blackbox (Praat/R scripts)**
   students provided with tool / materials

Hypothesis Generation

UNAV

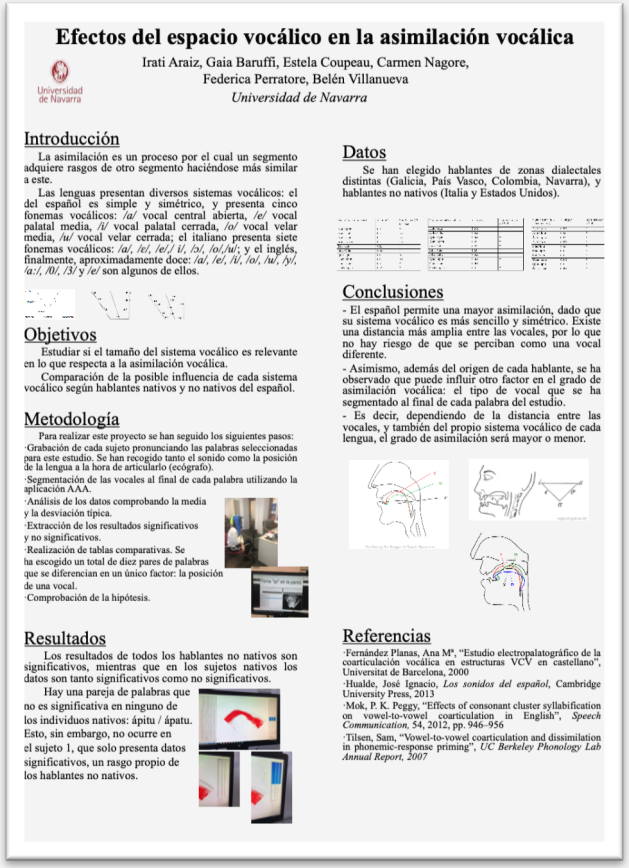
Setup: Mok's (2012) argument was that since codas in English are more constrained than onsets, then we should see more VCV coarticulation when C is an onset than when C is a coda.

Question: Given what we've seen with regard to onset vs coda complexity for Spanish in Hualde (2014), how do you think the syllable affiliation of the intervening consonant will affect VCV coarticulation in Spanish?

CMU

- Reading assignment: Ohman (1966)
  - written assignment: summary & question
  - several students independently formulated some of the hypotheses in question/comment
- Three groups, three Mok papers
  - informal class presentations to summarize
  - in-class discussion and refinement of hypotheses

Final Presentations



Efectos del espacio vocálico en la asimilación vocálica

Irati Araiz, Gaia Baruffi, Estela Coupeau, Carmen Nagore,
Federica Perratore, Belén Villanueva
Universidad de Navarra

Introducción

La asimilación es un proceso por el cual un segmento adquiere rasgos de otro segmento haciéndose más similar a este.

Las lenguas presentan diversos sistemas vocálicos: el del español es simple y simétrico, y presenta cinco fonemas vocálicos: /a/ vocal central abierta, /e/ vocal palatal media, /i/ vocal palatal cerrada, /o/ vocal velar media, /u/ vocal velar cerrada; el italiano presenta siete fonemas vocálicos: /a/, /ɛ/, /e/,/ i/, /ɔ/, /o/,/u/; y el inglés, finalmente, aproximadamente doce: /a/, /e/, /i/, /o/, /u/, /y/, /aː/, /ɒ/, /ɜ/ y /ɐ/ son algunos de ellos.

Objetivos

Estudiar si el tamaño del sistema vocálico es relevante en lo que respecta a la asimilación vocálica.

Comparación de la posible influencia de cada sistema vocálico según hablantes nativos y no nativos del español.

Metodología

Para realizar este proyecto se han seguido los siguientes pasos:

·Grabación de cada sujeto pronunciando las palabras seleccionadas para este estudio. Se han recogido tanto el sonido como la posición de la lengua a la hora de articularlo (ecógrafo).

·Segmentación de las vocales al final de cada palabra utilizando la aplicación AAA.

·Análisis de los datos comprobando la media y la desviación típica.

·Extracción de los resultados significativos y no significativos.

·Realización de tablas comparativas. Se ha escogido un total de diez pares de palabras que se diferencian en un único factor: la posición de una vocal.

·Comprobación de la hipótesis.

Resultados

Los resultados de todos los hablantes no nativos son significativos, mientras que en los sujetos nativos los datos son tanto significativos como no significativos.

Hay una pareja de palabras que no es significativa en ninguno de los individuos nativos: ápitu / ápatu. Esto, sin embargo, no ocurre en el sujeto 1, que solo presenta datos significativos, un rasgo propio de los hablantes no nativos.

Datos

Se han elegido hablantes de zonas dialectales distintas (Galicia, País Vasco, Colombia, Navarra), y hablantes no nativos (Italia y Estados Unidos).

Conclusiones

- El español permite una mayor asimilación, dado que su sistema vocálico es más sencillo y simétrico. Existe una distancia más amplia entre las vocales, por lo que no hay riesgo de que se perciban como una vocal diferente.
- Asimismo, además del origen de cada hablante, se ha observado que puede influir otro factor en el grado de asimilación vocálica: el tipo de vocal que se ha segmentado al final de cada palabra del estudio.
- Es decir, dependiendo de la distancia entre las vocales, y también del propio sistema vocálico de cada lengua, el grado de asimilación será mayor o menor.

Referencias

·Fernández Planas, Ana Mª, "Estudio electropalatográfico de la coarticulación vocálica en estructuras VCV en castellano", Universitat de Barcelona, 2000

·Hualde, José Ignacio, *Los sonidos del español*, Cambridge University Press, 2013

·Mok, P. K. Peggy, "Effects of consonant cluster syllabification on vowel-to-vowel coarticulation in English", *Speech Communication*, 54, 2012, pp. 946-956

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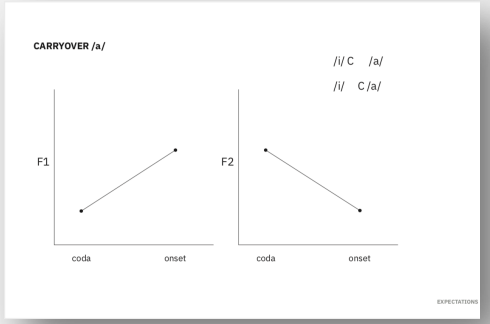

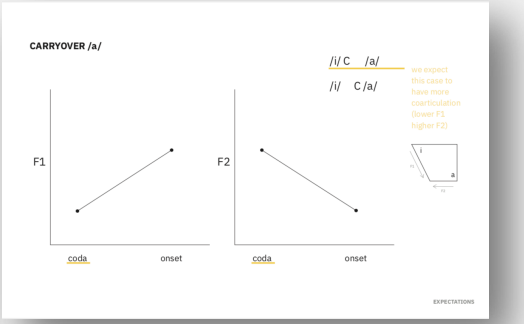

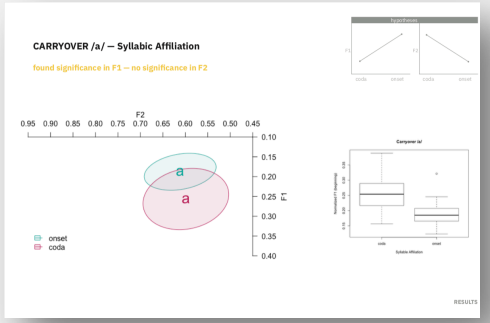

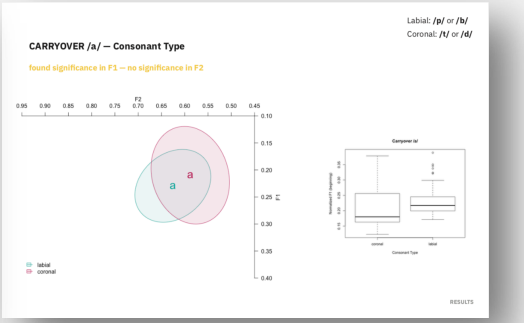

Video-conference

- End of semester video-conference between UNAV and CMU students
- Envisaged as open forum for students to share and discuss results
- Groups took turn presenting projects (MG & CB projected slides/posters)
  - UNAV students presented with help from MG (shyness due to English)
  - CMU students presented slide presentations
- Future: put students in contact at the beginning of the semester
- Overall, a success!

Sample Survey Responses: UNAV

Pre-project

- How comfortable do you feel working with numbers?
  100% answered moderately or very uncomfortable.
- What is your weak point with respect to this project?
  Quantitative analyses, mathematical intelligence, statistics represented 80% of responses.
- What most excites you about taking part in a scientific research project:
  *"Opportunity to acquire practical skills"", **"To see how authors of text books corroborate what's in their texts"**, "To learn a new software package", **"To take part in a real scientific study"***

Post-project

- How comfortable do you feel working with numbers now that you've performed your own study?
  100% answered average to very comfortable. (Yeeeeaaaa!!!)
- If you were to do another quantitative analysis, how comfortable would you feel now that you have done this project
  100% responded comfortable to very comfortable? (another Yeeeeaaaaa!!!)
- Do you think your problem solving skills have improved due to this project?
  90% responded positively. (a third 'yea' would just be an ego trip :)

Individual Skillsets: "What skill did you contribute?"

UNAV

- *"Efficiency"*
- *"Leadership and organization"*
- *"Capacity to synthesize and summarize results"*
- *"Organization, familiarity with the ultrasound system"*
- *"Constancy"*
- *"Writing skills for writing up the results"*
- *"Communication skills"*
- *"Technical skills, I like learning new software packages"*

CMU

- *"Keeping everyone on track"*
- *"Reasoning through hypotheses and results"*
- *"Quantitative skills"*
- *"Writing"*
- *"Preparing the presentation"*
- *"Organization"*
- *"Past experience with research"*
- *"Communication"*

Every student found their niche, and worked with the group to facilitate the project.

Sample Survey Responses: CMU

Most important thing learned

- ***"Do every part over the course of the semester and then the final paper isn't that bad!"***
- *"I learned that it is much more **grunt work** than expected."*
- *"I have learned to really **pay attention to small details** and how to accomplish a lot of work **efficiently**"*
- *"That it's very easy for large projects **not to go as expected**, and you have to be **prepared to learn new things on the fly**, or change directions whenever necessary."*
- *"I am much more **organized** now."*
- ***"Get everyone on the same page. Clearly articulate the goals of the research, the hypotheses, the materials, and the processes from the outset. Make sure everyone knows exactly what is expected of them. Don't go to grad school."***

What did you appreciate?

- ***"I loved the hands on experience."***
- *"I appreciated the **constant reflections and feedback sessions** we had in class. …I think that helped us work together as a class."*
- ***"We got some findings! Talking to the group in Spain was a really cool experience"***
- *"You did a very good job of **acknowledging the difficulty** of the project and always **asking for ways to improve** it in the future."*
- ***"I appreciated that you knew your stuff (or at least seemed to). That made me feel safe when I wanted to try something new or needed clarification."***

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Future Implementation

- Reduce/reorganize work load
  - Start segmentation earlier
  - Less data!
  - Make hypotheses more balanced in terms of work / complexity
- Mid-semester show and tell by different groups
- Connect CMU/UNAV students in earlier in the semester and connect them with the other faculty member earlier as well

Moving Forward with C.A.R.E

- Further develop Collaborative Active-learning Research-based Education
- Invite new collaborations from other universities/labs
- Create an online database of research projects with tutorials and guides, from simple to progressively more complex subject matter
- Create a community of professors and undergraduate students oriented toward research in Phonetics and Phonology

Thank you!
¡Gracias!

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Mark Gibson: mgibson@unav.es

Additional slides

Classes at CMU / UNAV: Phonetics & Phonology

UNAV

- 3rd year Spanish philology students
- 16 students (12 Spain; 3 Italy; 1 US)
- None trained in quantitative analysis / statistics
- Previous linguistics courses:
  - Introduction to linguistics
  - Morphosyntax
  - History of the Spanish language
  - Semantics
- None had previous experience in research

CMU

- 2nd – 4th year linguistics majors / minors
- 14 students (13 US; 1 Canada)
- Most had introductory statistics (college req.)
- Diverse other majors/minors: CS, math, design, psych, information systems
- Previous linguistics courses (minimum):
  - Introduction to linguistics
  - Phonetics & Phonology I
- Some had limited experience in research

Project Evaluation

- Pass/fail structure for early stages of data collection (CMU)
- Short written assignments
- Dossiers with all work documented (UNAV)
- Recording / segmentation quality (CMU)
- Posters / presentation
- Final paper (CMU)
- Peer review

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   students guided through already-made decisions
3. **blackbox**
   students provided with tool / materials

Literature & Hypothesis Development

Literature

- Curating literature: blackbox
- Reading/responding/presenting: active-learning

1. Fernández Planas, A.Mª (2000). Estudio electropalatográfico de la coarticulación vocálica en estructuras VCV en castellano. PhD dissertation, Universitat de Barcelona.
2. Gay, T. (1977). "Articulatory movements in VCV sequences", *The Journal of the Acoustical Society of America,* 62(1) 183–193.
3. Mok, P. (2010). "Language-specific realizations of syllable structure and vowel-to-vowel coarticulation". *The Journal of the Acoustical Society of America,* 128 1346–1356.
4. Mok, P. (2011). "Effects of consonant cluster syllabification on vowel-to-vowel coarticulation in English". *Speech Communication* 54, 946–956.
5. Mok, P. (2012). "Does Vowel Inventory Density Affect Vowel-to-Vowel Coarticulation?" *Language & Speech*, 56(2) 191–209.
6. Ohman, S. (1966). "Coarticulation in VCV Utterances". *The Journal of the Acoustical Society of America*, 39 151–168.
7. Przezdziecki, Marek (2000). "Vowel harmony and vowel-to-vowel coarticulation in three dialects of Yorùbá". *Working Papers of the Cornell Phonetics Laboratory,* 13 105–124.
8. Tilsen, S. (2007). "Vowel-to-vowel coarticulation and dissimilation in phonemic-response priming". UC Berkeley Phonology Lab Annual Report.

Hypothesis Development

- Simulated
- Developed ahead of time by MG & CB (also stimuli)
- 4 hypotheses
  1. Vowel density
  2. Syllable affiliation of C: V.CV *vs.* VC.V
  3. Degree of constriction of C
  4. Number of intervening C
- Students were led to articulation of hypotheses based on literature, through guided discussions and written prompts

Hypotheses

Simulating hypothesis generation prompted students to consider issues such as:

- Directionality in VCV coarticulation (anticipatory, carryover)
- Explanation: biomechanical versus linguistic
- Interaction between degree and manner of articulation of intervening C
- Syllabic affiliation and relationship between C and V
- How much material can separate vowels?
- Vowel density (phonological, phonetic, etc.); see Mok (2012)

Data Collection: Full engagement

UNAV

- Students subjects and researchers
- Data collected 2nd week of class before students knew what study was about ("just an experiment for a crazy professor!")
- Students instructed in ultrasound methodology (probe placement)
- Written tutorial in Spanish; students filmed demo
- 1st subject run by MG; other subjects run by students (with MG present)

CMU

- Students had to recruit participants themselves; 2 students were subjects (recorded by CB)
- Data collected between weeks 4–6; each student recorded 2 participants (30 total)
- Demo of recording method in class; students did a "recording quiz" with CB as subject
- Written tutorial in English
- Students recorded in quiet room on campus; CB not present

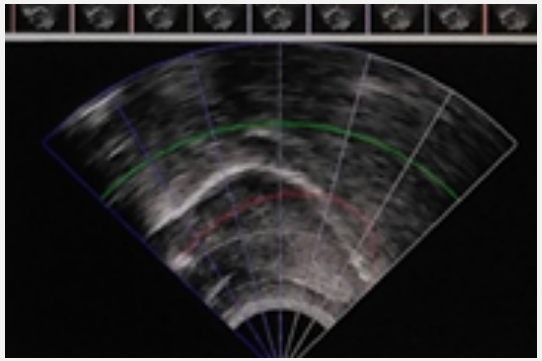
Participants remunerated $10; thanks to CMU Philosophy for funding.

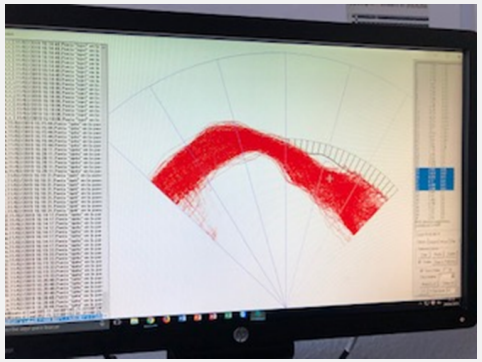
Segmentation Procedures: Full engagement

UNAV

Ultrasound segmentation (per hypothesis)

1. segment vowels in AAA software
2. automatic tracking software (trace tongue contours)
3. correct by hand





CMU

Segmentation in PRAAT (per speakers recorded)

- Provided with PRAAT scripts to facilitate analysis
- One student created Python script (Parselmouth) to improve it!

Both classes provided with guidance:

- written tutorial (UNAV)
- extra class session (CMU)

Outlier Detection (CMU): Full engagement

- Plotted vowels to determine potential errors (human or computer)
  - phonR 1.0.7
  - scripts written by CB
- Manually check potential outliers due to segmentation / measurement errors
  - were asked to determine own boundaries
  - this was scary for them!

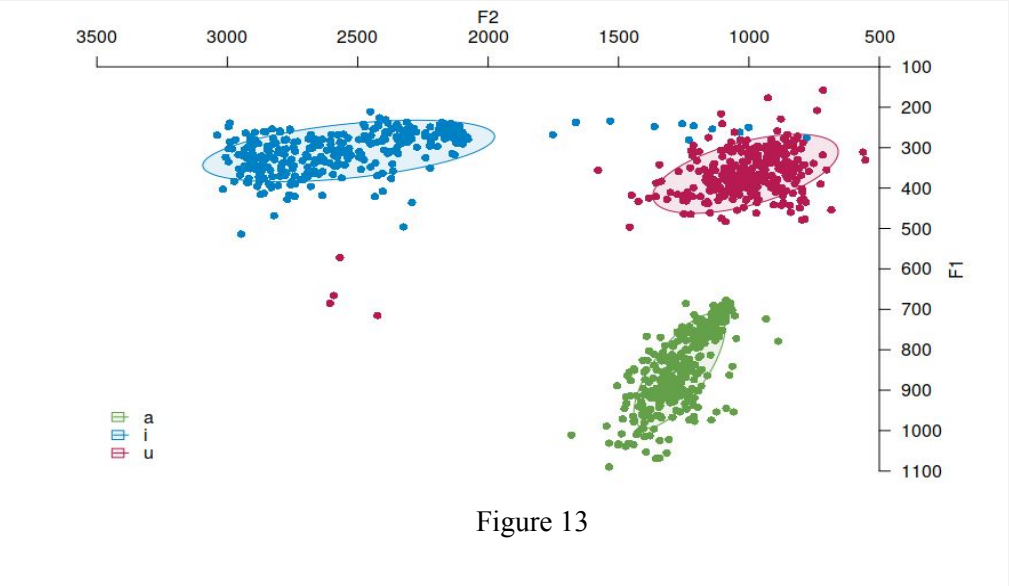
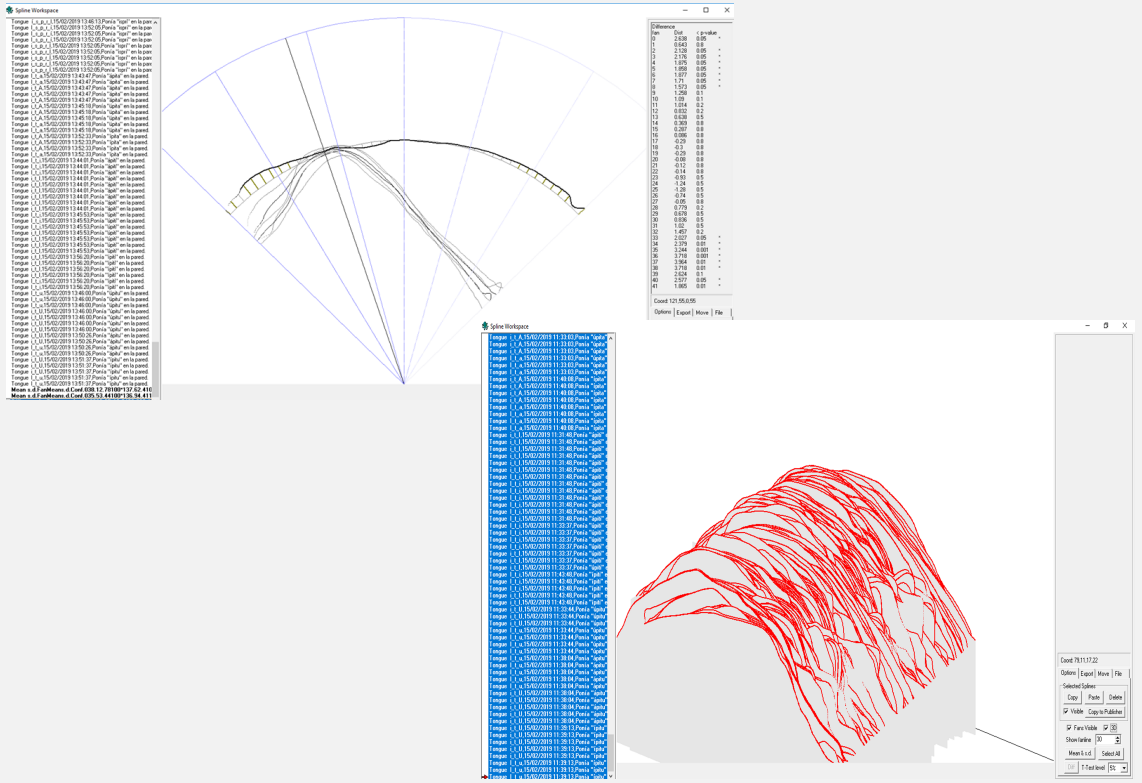


Figure 13

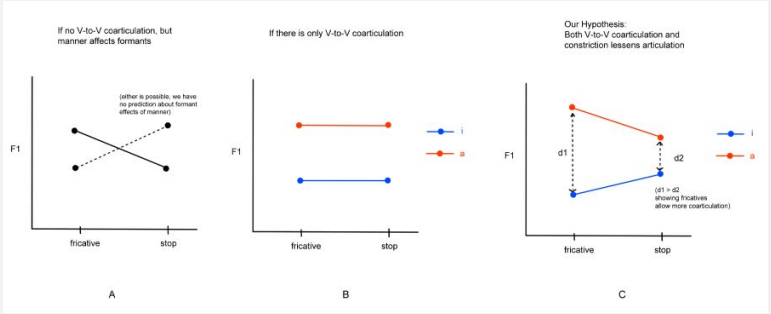
Statistical Analysis: UNAV

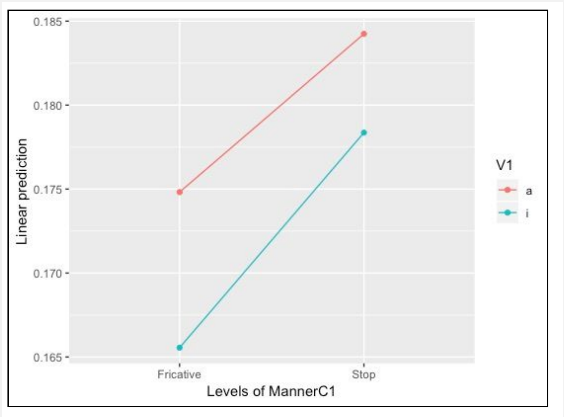
- Active-learning & blackbox
- AAA software (blackbox)
  - calculates means and standard deviations
  - performs *t*-tests for tongue contours
- Extracurricular tutorial (active-learning)
  - practical exercises
  - focus on understanding conceptual underpinning of *t*-test



Statistical Analysis: CMU

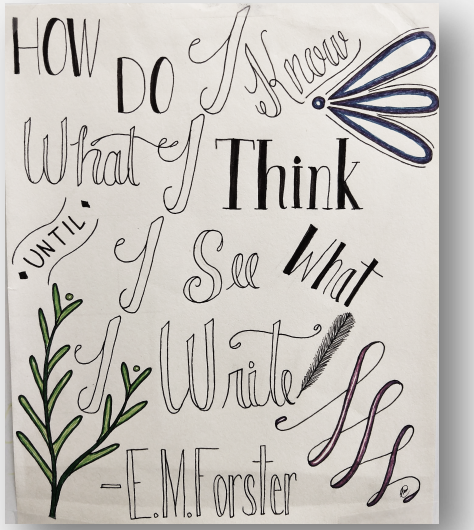
- Full engagement & blackbox
- R scripts (blackbox)
  - High-level lecture re: hypothesis testing
  - Provided with R scripts to run (simple) linear mixed model (lmer) analysis
- Interpretations (full engagement)
  - Group-specific meetings
  - Guided to articulate hypotheses in terms of expected interactions between factors
  - Interpretation of interaction plots





Linking Individual and Group Work: Write-Ups

- Short, individual write-ups and reflections throughout semester
- These acted as first drafts for final paper/ poster (group submission)
- Pedagogical goals:
  - frequent writing
  - "writing to think"



Part 1: Measures & Outlier detection

Your methodology paragraph must answer the questions below. You need to include enough information so that the study is replicable, but you should write in such a way so that it reads smoothly, and not as a bullet point list made prose.

Measures

- What measures on the data were taken?
- Did you use the Praat script or Python script? I.e., what was the workflow?
- What parameters were used?

Outlier detection

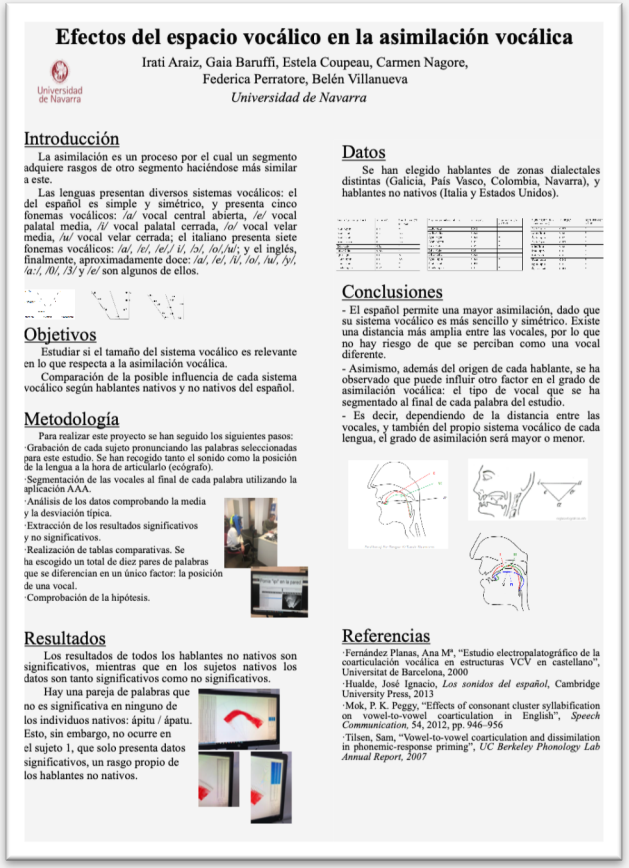
- What was done to examine the data in order to ensure uniformity across investigators?
  - What kinds of issues arose?
  - What was done about these issues? What was fixed, what was deleted, etc? Who fixed what?
- How were outliers identified?
  - What criteria were used to determine whether a token was an outlier or not?

Part 2: Reflection

Write a short paragraph reflecting on the experience of taking measures and identifying outliers. What went well? What could have gone better? What were errors on your part, and what organizational elements could have gone better with respect to the course? (I have my list, I want to see yours!) Do you have suggestions for the next time? Did your experience carrying out measures and outlier detection proceed according to your expectations / comfort level?

Poster Presentations: UNAV

- Extra-curricular poster session with another class also doing research projects
- Rubrics provided with assignment.
- Evaluated by professors from the Spanish Philology Dept (using rubrics)
- Teaching:
  - Tutorial session on preparing scientific poster
  - MG prototypes provided as template



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Se han elegido hablantes de zonas dialectales distintas (Galicia, País Vasco, Colombia, Navarra), y hablantes no nativos (Italia y Estados Unidos).

Conclusiones

- El español permite una mayor asimilación, dado que su sistema vocálico es más sencillo y simétrico. Existe una distancia más amplia entre las vocales, por lo que no hay riesgo de que se perciban como una vocal diferente.
- Asimismo, además del origen de cada hablante, se ha observado que puede influir otro factor en el grado de asimilación vocálica: el tipo de vocal que se ha segmentado al final de cada palabra del estudio.
- Es decir, dependiendo de la distancia entre las vocales, y también del propio sistema vocálico de cada lengua, el grado de asimilación será mayor o menor.

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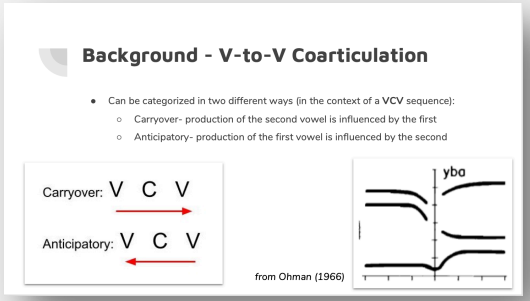
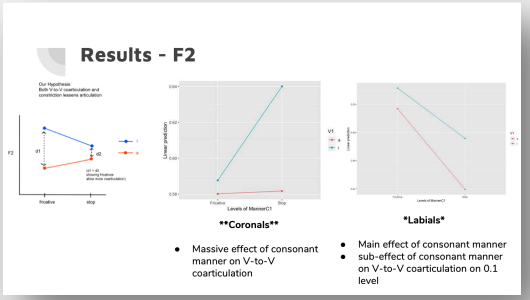
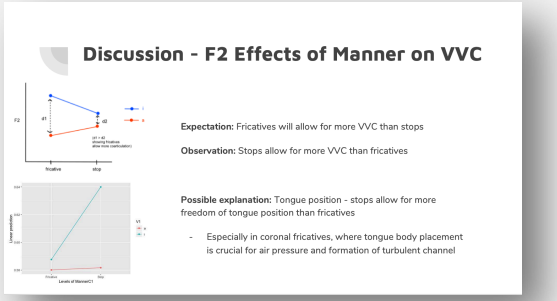
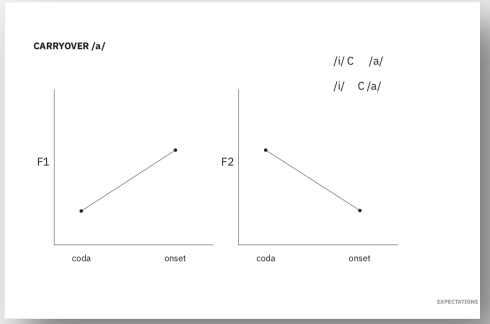
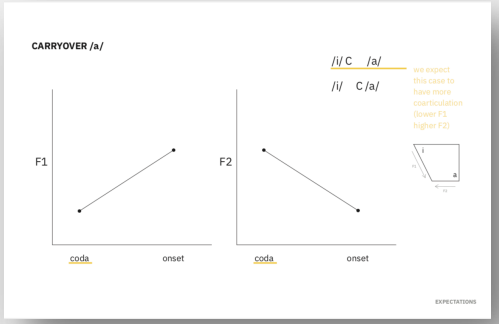
Slide Presentations: CMU

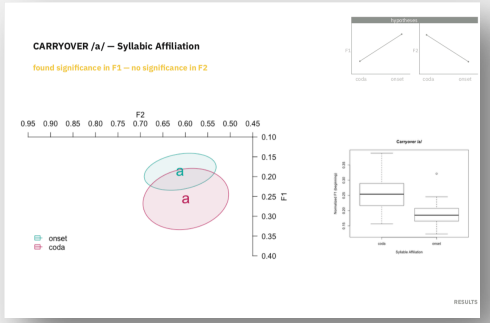


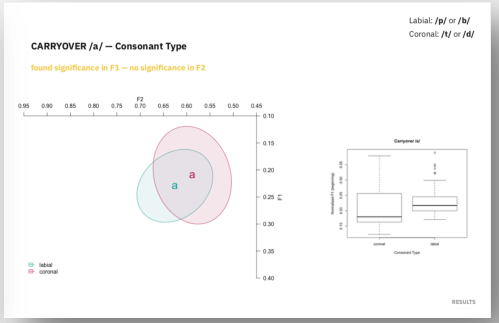












Video-conference

- End of semester video-conference between UNAV and CMU students
- Envisaged as open forum for students to share and discuss results
- Groups took turn presenting projects (MG & CB projected slides/posters)
  - UNAV students presented with help from MG (shyness due to English)
  - CMU students presented slide presentations
- Future: put students in contact at the beginning of the semester
- Overall, a success!

Pre- & Post-Conceptions

- Distributed before study to assess:
  1. preconceptions of doing research study
  2. background: skills, courses
  3. work habits: organization, punctuality, communication
  4. group members: requests / anti-requests
- Groups formed on basis of answers to distribute skill sets

- Distributed after study to assess:
  1. comfort level if they were to begin a new research study
  2. their contributions to group; growth in skills
  3. improvement in work habits
  4. reflection on group work
  5. suggestions for future implementations

Sample Survey Responses: UNAV

Pre-project

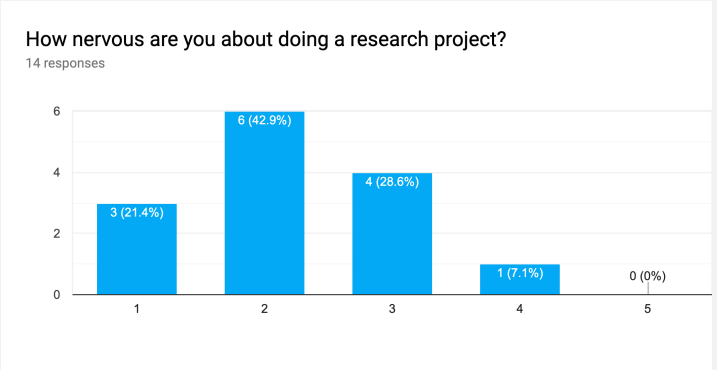
- How comfortable do you feel working with numbers?
  100% answered moderately or very uncomfortable.
- What is your weak point with respect to this project?
  Quantitative analyses, mathematical intelligence, statistics represented 80% of responses.
- What most excites you about taking part in a scientific research project:
  "Opportunity to acquire practical skills"", ***"To see how authors of text books corroborate what's in their texts"****, "To learn a new software package",* ***"To take part in a real scientific study"***

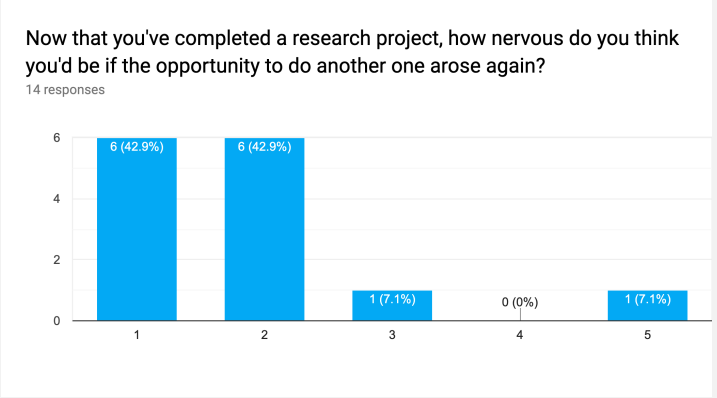
Post-project

- How comfortable do you feel working with numbers now that you've performed your own study?
  100% answered average to very comfortable. (Yeeeeaaaa!!!)
- If you were to do another quantitative analysis, how comfortable would you feel now that you have done this project
  100% responded comfortable to very comfortable? (another Yeeeeaaaaa!!!)
- Do you think your problem solving skills have improved due to this project?
  90% responded positively. (a third 'yea' would just be an ego trip :)

Sample Survey Responses: CMU

- Groups balanced for skill, background level, etc.
- Data analysis stage:
  - worked as a group to write up reports
  - were allowed to specialize
  - were not allowed to "tune out" of each others' work
- Half were CS and/or math majors; 1 cognitive science; 1 information systems; 1 psychology, so each group had at least one person comfortable running provided scripts and reasoning about numbers





Individual Skillsets: "What skill did you contribute?"

UNAV

- *"Efficiency"*
- *"Leadership and organization"*
- *"Capacity to synthesize and summarize results"*
- *"Organization, familiarity with the ultrasound system"*
- *"Constancy"*
- *"Writing skills for writing up the results"*
- *"Communication skills"*
- *"Technical skills, I like learning new software packages"*

CMU

- *"Keeping everyone on track"*
- *"Reasoning through hypotheses and results"*
- *"Quantitative skills"*
- *"Writing"*
- *"Preparing the presentation"*
- *"Organization"*
- *"Past experience with research"*
- *"Communication"*

Every student found their niche, and worked with the group to facilitate the project.

Sample Survey Responses: CMU

Most important thing learned

- ***"Do every part over the course of the semester and then the final paper isn't that bad!"***
- *"I learned that it is much more grunt work than expected."*
- *"I have learned to really pay attention to small details and how to accomplish a lot of work efficiently"*
- ***"That it's very easy for large projects not to go as expected, and you have to be prepared to learn new things on the fly, or change directions whenever necessary."***
- *"I am much more organized now."*
- ***"Get everyone on the same page. Clearly articulate the goals of the research, the hypotheses, the materials, and the processes from the outset. Make sure everyone knows exactly what is expected of them. Don't go to grad school."***

What did you appreciate?

- ***"I loved the hands on experience."***
- *"I appreciated the constant reflections and feedback sessions we had in class. …I think that helped us work together as a class."*
- ***"We got some findings! Talking to the group in Spain was a really cool experience"***
- *"You did a very good job of acknowledging the difficulty of the project and always asking for ways to improve it in the future."*
- ***"I appreciated that you knew your stuff (or at least seemed to). That made me feel safe when I wanted to try something new or needed clarification."***

Future Directions

- Make the class more units (12 units instead of 9) or make it its own class (CMU) (i.e., this was a lot of work!)
  - Start segmentation earlier
  - Less data!
  - Make hypotheses more balanced in terms of work / complexity
- Add a separate weekly lab session
- Meet not just with own group members, but meet with other groups to get fresh perspective
- Connect CMU/UNAV students in earlier in the semester

Phonological Theme: Vowel Harmony

UNAV

- Students covered diachronic cases of vowel harmony in Spanish (Hualde, 2014).
- Looked at two different ways to deal with vowel harmony theoretically and compared the two approaches:
  - Autosegmental Phonology
  - Articulatory Phonology (based on Benus & Gafos, 2007).

CMU

- Students had studied vowel harmony in *Phonetics & Phonology I*
- Goal: illustrate how different theoretical paradigms tackle vowel harmony, and development of field
  - SPE (& pre-SPE)
  - Autosegmental Phonology
  - OT
- Problem sets, class lectures, readings
  - Przezdziecki, (2000). "Vowel harmony and vowel-to-vowel coarticulation in three dialects of Yorùbá".

Integration of Research Study & Phonology Theme

- Room for improvement
- Time
  - add additional class meeting / create separate undergraduate course
  - reduce complexity/size of project/hypotheses
- Experience
  - development of tools/tutorials/rubrics will make execution smoother
  - first time for everything!
- Collaboration

Thank you!
¡Gracias!

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